Sustainable National Income 2005: Analysis for the Netherlands - Trend and decomposition analysis of a Sustainable National Income in 2005 according to Hueting's methodology

Dellink, R.B.; Hofkes, M.W.

2008

Sustainable National Income 2005: analysis for The Netherlands

Trend and decomposition analysis of a Sustainable National Income in 2005 according to Hueting's methodology

Dr R. Dellink and Prof. Dr M.W. Hofkes

R-08/06

December 23, 2008

This report was commissioned by: The Netherlands Environmental Assessment Agency

It was internally reviewed by: Prof. Dr H. Verbruggen

IVM

Institute for Environmental Studies
Vrije Universiteit
De Boelelaan 1087
1081 HV Amsterdam
The Netherlands

T +31-20-5989 555
F +31-20-5989 553
E info@ivm.vu.nl

Contents

Abstract

In this study we calculate and analyse the Sustainable National Income according to Hueting's methodology for the Netherlands in 2005. Hueting's Sustainable National Income (SNI) indicator is a "green" income measure that assumes an absolute preference for conservation of the natural environment.

For the themes Depletion of the ozone layer, Eutrophication, Smog formation and Dispersion to water, the emission levels have been steadily decreasing since 1990, and emission levels in 2005 can be considered sustainable without any need for additional policies. There are a number of persistent environmental problems, however: the (enhanced) greenhouse effect, Acidification, Dispersion of fine particles to air, Dehydration and Soil contamination. For these themes, the sustainable level of emissions remains substantially below the current emission levels.

According to the SNI calculations for 2005, national income substantially decreases when the sustainability standards are met. Not unexpectedly, bridging the last part of the gap between the current emission levels and the sustainability standards involves the highest cost and causes the major part of reduction in SNI. The specification of international trade significantly affects the results. When world market prices are assumed to be constant (variant 1), the restructuring of the economy can be less drastic, and hence SNI is substantially higher than when world market prices are assumed to be affected by international sustainability policies (variant 2). SNI variants 1 and 2 amount to 336 and 252 billion Euro, respectively. That is 22 and 42 percent lower than net national income. In both variants sustainable national income has increased over the last five years simultaneously with the (unsustainable) net national income. This implies that the over-dependence of the Dutch economy on natural resource exploitation has not increased.

1. Introduction

It is well understood that national income is an inadequate indicator of social welfare. Depending on the perspective, national income is either incomplete, misleading, or both. Many attempts have been made to improve and/or supplement this central statistic of national accounts. One of these attempts, the correction of national income for environmental losses, has extensively been dealt with in Verbruggen (2000), Verbruggen *et al*. (2001), Gerlagh *et al*. (2002), Hofkes *et al*. (2002) and Hofkes *et al*. (2004). The methodology used in these studies resulted in a so-called Sustainable National Income (SNI), i.e. a national income that takes the environment as a welfare generating economic good into account, according to the methodology strongly advocated by Hueting (e.g. Hueting, 1974). In this study we calculate and analyse the Sustainable National Income according to Hueting's methodology for the Netherlands in 2005. By using the same methodology as in the previous studies, we can directly compare the results for 2005 with results of earlier analyses and conduct a trend analysis.

In operationalising the Hueting methodology, an empirical and integrated environment-economy model has been used. The use of such a model inevitably asks for the formulation of a number of choices and additional assumptions to make the model run and come up with credible results. It is clear that these choices and additional assumptions can be questioned, even though they are extensively examined in the above-mentioned studies. To deal with the sensitivity of the results we focus our investigation on a trend and de-composition analysis.

Section 2 provides the main information in the methodology that is used to calculate the SNI2005. While the section aims at being stand-alone comprehensible, it heavily draws on the more elaborate descriptions of the methodology in the above-mentioned earlier SNI studies. Section 3 deals with the calibration of the model to the year of investigation, 2005; this section provides insight into the state of the Dutch economy in 2005. Section 4 presents the results of the numerical analysis, while Section 5 concludes.

2. Methodology

2.1 Sustainable National Income according to Hueting

Hueting's Sustainable National Income (SNI) indicator is a "green" income measure that avoids problems related to an uncertain future, and specifically to uncertain future preferences. Hueting suggests that we should assume an absolute preference for conservation of the natural environment (*e.g.* Hueting, 1974, 1992 and 1995). He argues that under this assumption, the value of environmental degradation is equal to the conservation costs, i.e. the costs to preserve the environment and remove existing environmental burden. In this sense, the SNI indicator resembles the maintenance cost approach (UN 1993a).

The gap between the NNI and the SNI level measures the dependence of the economy on that part of its natural resource use that exceeds the sustainable exploitation levels. If the NNI level increases substantially while the SNI level increases less, that is if the gap between the two measures increases over time, the conclusion can be drawn that the basis for economic growth is unsustainable. Growth is then accompanied by an increase in natural resource use, and the dependence of the economy on over-exploitation of natural resources increases. On the other hand, if the *absolute* gap between the NNI level and the SNI level decreases over time, this points to a decrease in the economy's overdependence on natural resources. For policy makers, who are mainly interested in the economic and political feasibility of environmental regulation, an increase in the gap signifies that an increasing effort will be required to implement actual sustainability measures, while a closing of the gap indicates a decrease in the economy's dependence on natural resources. In this sense, the dynamics of the SNI vis-à-vis the NNI is of apparent relevance for actual environmental policy.

From a methodological point of view, we can distinguish two steps in making the calculations of a SNI indicator. First, sustainable resource use is defined and compared with actual resource use. This procedure is based on insights from natural sciences (Hueting and Reijnders, 1998). Second, direct and indirect changes in income caused by the required changes in resource use are calculated by use of an economic model such as an Applied General Equilibrium (AGE) model. The second step is familiar to many economic analysts. However, it requires an extension of the standard AGE model to account for the specific data on the interaction between environmental and economic variables.

2.2 The SNI-AGE model

The SNI-AGE model is a so-called Applied General Equilibrium (AGE) model. For a comprehensive description of the model, its assumptions and calibration the reader is referred to Dellink *et al.* (2001), Gerlagh *et al.* (2001), Verbruggen *et al.* (2001), Gerlagh *et al.* (2002), and Hofkes *et al.* (2002, 2004). Here, we only provide a brief introduction to the model.

The main advantage of using a general equilibrium model is that such models allow for a comprehensive and consistent approach, while being able to take all indirect effects into account. Basically, a general equilibrium model consists of a set of "economic agents", each of which demands and supplies commodities or "goods". Agents are assumed to behave rationally. Each agent solves his or her own optimisation problem. The agents take the prices, which give information about the decision environment, as given. Equilibrium is defined as a state of the economy in which the actions of all agents are mutually consistent and can be executed simultaneously. Equilibrium is attained by adjusting the prices.

In our analysis, we follow Hueting and interpret sustainable income as reflecting the situation of the economy after an instantaneous change towards sustainable resource use. In this thought, transition dynamics do not matter, and the SNI calculations should not be burdened with transition costs. Thus, we can restrict the analysis to a comparative-static description of the economy[1].

The model has 27 sectors, and is extended to account for 9 environmental themes. The SNI-AGE model identifies domestically produced goods by the sectors where these goods are produced. There are two primary production factors, labour and capital.[2] The model distinguishes three consumers: the private households, the government, and the Rest of the World (ROW). In addition to these producers and consumers, there are several auxiliary agents that are necessary to shape specific features of the model. In order to capture non-unitary income elasticities in the model, the consumption of the private households is split into a "subsistence"' and a "luxury" part. There is an "investor" who demands investment goods necessary for economic growth, and a "capital sector" which produces the composite capital good. Trade is modelled using the Armington specification for imports and a Constant Elasticity of Transformation (CET) production structure for sectors producing for both the domestic and the world market.[3] Besides the model elements mentioned above, common to many other AGE models, the model distinguishes 9 environmental themes: enhanced greenhouse effect, depletion of the ozone layer, acidification, eutrophication, smog formation (tropospheric ozone), dispersion of fine particles to air, dispersion of toxic substances to water, dehydration, and soil contamination. To each of the environmental themes, aggregated emission units are associated. For example, to the enhanced greenhouse effect, greenhouse gas emissions are associated, which are expressed in CO_2 equivalents. The two themes, dehydration and soil contamination are special cases, in the sense that they are inheritances from the past, not caused by annual pollution. The reduction costs are not costs of pollution reduction but total costs of cleaning up and restoration. For these themes, an abatement cost curve is not relevant; in the model just an estimate of the annual costs involved are included into the analysis in the form of government expenditures on abatement.

---

1 Dellink (2005) investigates how the SNI calculations for 1990 would be affected by alternative assumptions regarding the dynamics of the economy.

2 In fact, capital is produced. The model accounts for maintenance costs and net investments.

3 The CET production function is used for production processes with multiple output goods. In analogy to the CES production function, it is assumed that the relative change in output for the various output goods is proportional to the relative change in prices. For example, if there are two goods and their initial output levels are the same, then if the price of the first good increases by 1%, the relative output level of the first good will increase with σ%, where σ is the elasticity of transformation parameter.

An overview of the relationships in the model is presented in Figure 2.1 In the figure, black arrows represent commodity flows that are balanced by inverse income flows; grey arrows represent pure income transfers that are not balanced by commodity flows.

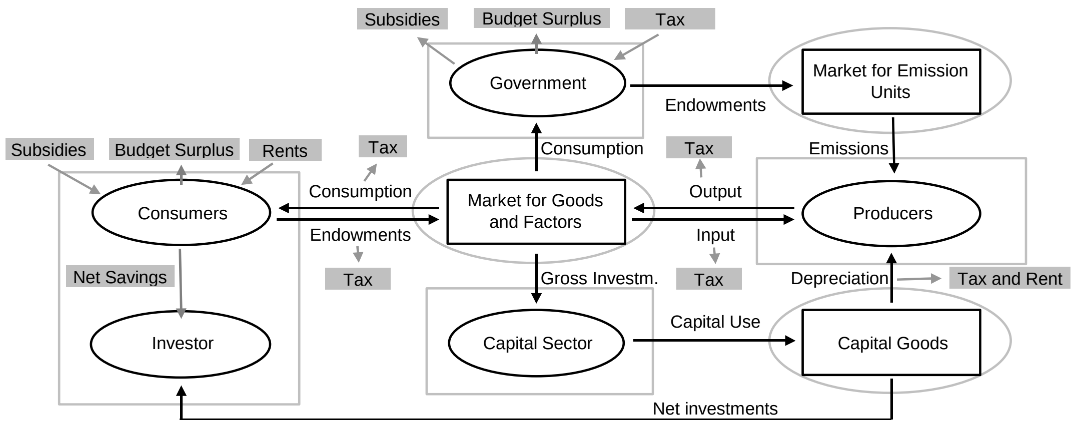

Figure 2.1 Overview of SNI-AGE model.

Demand and Supply

Demand and supply meet on the markets for goods and factors. The private consumers supply endowments (labour) that are used as inputs by the producers. The producers supply output of produced goods, which balances consumption by the private and public consumer and inputs for gross investments. Part of these investments reflects the depreciation of the capital stock, the remaining part, net investments, is used to sustain economic growth in the next period. The figure also shows the market for emission units, supplied by the government in an amount that is consistent with the sustainability standards. Hence, the revenues from the sale of emission units enter the government budget.

Government

The government levies taxes on consumption (VAT), the supply of endowments (labour income tax), and capital use (profit income tax). These public revenues balance, together with revenues from the sale of emission units, the public expenditures that consist of public consumption and lump sum subsidies for social security. Consumers spend their income from the sale of endowments and lump sum subsidies on consumption and net savings. Net savings are transferred to the “investor:, who spends it on the consumption of capital goods (thus: net savings equal net investments).

Balancing Budgets

Production technologies are assumed to have constant returns to scale, which implies that profits, apart from a rate of return on capital, are zero, and hence, that the value of inputs is equal to the value of outputs. In Figure 2.1 , this is visualized by placing a grey box around the agents, over which the net income and expenditure flows sum to zero. The same applies to clearing markets, where (the value of) total supply matches total demand. A grey ellipse visualizes this.

By a careful examination of the income flows in Figure 2.1, we find that the budgets close, except for the budget balances of the private and public consumers. This is due to the omission of international trade from the figure. For the domestic economy as an entity, the budget surplus is equal to the surplus on the trade balance, represented through the well-known identity Y = C+I+(X–M), where Y–C–I is the income surplus of the consumers compared to the expenditures on consumption and investments, and (X–M) is the surplus of export compared to the imports. Of course, in case of a budget deficit the opposite holds.

Methodological Assumptions

Given the AGE model, calculation of the sustainable income follows the same procedure as a classic policy analysis, i.e., in which one studies the consequences of a policy that strictly meets environmental sustainability standards. It is then necessary to make assumptions as to the time scale (e.g. static versus dynamic modelling), transition costs, labour market, international trade, emission reduction measures, "double counting", private consumption and government budgets. We have to be aware that results may significantly depend on the actual assumptions. It is thus not possible to consider the result as the unique SNI; preferably, we speak of an SNI calculation.

Regarding assumptions with respect to international trade, we calculate two variants. The specific assumptions made in these two variants are explicated below.

To calculate an SNI for a particular country, assumptions have to be made with respect to policies in the rest of the world. This is especially relevant for a small and open economy such as the Netherlands, as a unilateral sustainability policy could cause a major international reallocation of relatively environment-intensive production activities. We assume that similar sustainability standards are applied all over the world, taking due account of local differences in environmental conditions. However, it is not feasible to estimate the resulting costs and changes in relative prices in other countries. Instead, we have to make some simplifying assumptions, and in the results presented in this report, we present two variants.

The first variant abstracts from changes in prices on the world market. As relative prices in the Netherlands change, it becomes feasible for the Netherlands to partly reach its sustainability standards by importing relatively environment-intensive products, whose cost of production increase relatively much in the Netherlands, and by exporting less environment-intensive products, whose cost of production will relatively decrease in the Netherlands. The second variant assumes price changes on the world market proportional to price changes in the Netherlands and can be implemented in the model through an assumption that international trade elasticities are set to zero. This variant implies a more stringent restructuring of the Dutch economy, as shifting environmental problems abroad is no longer possible.

In the same international context, we have to specify an assumption concerning the trade balance. In the AGE model, the standard macro-economic balance equations apply, so that the sum of the public and private savings surpluses (or deficits) equals the trade balance deficit (or surplus). The savings surplus is assumed to constitute a constant share of national income. This, in turn, determines the trade balance through adjusting the exchange rate.

2.3 Counting national income

Several definitions can be used as aggregate measure of the “marketed activity” of the economy; these are defined and described in detail in the UN Handbook on National Accounting (1993b); here we only provide a brief overview. The most commonly used in *Gross Domestic Product* (GDP). GDP essentially refers to the total value added that is generated by economic activities in the economy, i.e. the output of the production sectors minus the intermediate deliveries.

Gross National Product can be obtained by correcting for (primary) income by residents obtained abroad and income generated by non-residents in the Netherlands. Thus, one could say that “domestic” refers to “in the Netherlands”, whereas “national” refers to “by the Dutch”.

GDP and GNP both contain depreciation (“consumption of fixed capital” in the terminology of UN, 1993b) as a component of the aggregate measure. Depreciation is however noteworthy for being difficult to measure, and theoretically, it should not be part of an aggregate measure of value added, as it refers to consumption of existing capital and not to the creation of new value. Therefore, an insightful indicator can be constructed by subtracting depreciation from GNP: *Net National Product* (NNP).

Instead of looking at national product, one can also measure national income. At any given moment in time, national income equals national product by definition; thus *Net National Income* (NNI) equals NNP. In the model calculation of a Sustainable National Income, relative prices will start to shift however, and therefore NNI and NNP will not be identical when measured at new equilibrium prices (note that the calculated Sustainable National Income will equal Sustainable National Product in the model calculations).

The UN Handbook on National Accounting (1993b) describes *net national income* as follows: “The aggregate value of the net balances of primary incomes summed over all sectors is described as net national income (NNI). Similarly, the aggregate value of the gross balances of primary incomes for all sectors is defined as gross national income (GNI). The latter is identical with gross national product (GNP) [...]. However, conceptually, both NNI and GNI are measures of income and not product.”

Apart from these textbook definitions of national income and national product, we discuss two features of Hueting’s SNI that concern the interpretation of the numerical results, rather than the modelling itself. These two features are the use of prices from the current unsustainable economy, in contrast to the use of prices from the sustainable economy, and the correction of income for so-called double counting.

If the costs of measures to meet the sustainability standards are directly deducted from national income, it is conceivable to use the current market prices as a first approximation. If, however, SNI calculations are made with the help of an applied general equilibrium model, relative prices change, i.e. prices of environment-intensive products will generally increase compared to other products. The question now is in which set of prices SNI could best be expressed, such that a comparison with the original national income figure can be ascribed a meaningful interpretation. The two best-known income measures are named after Laspeyres and Paasche, using the initial prices and new prices to aggregate goods, respectively.

If the set of relative prices of the base situation (Laspeyres index) is used to weigh the volumes of the SNI, consistency between sustainable national income and sustainable national product is lost, because the volume shares of a SNI will differ from the original national income. Furthermore, an SNI results in a new set of equilibrium prices and it is at odds with the sustainability concern not to use these prices reflecting the true scarcities. Therefore, we adopt the Paasche price index to express national income. Note that in equilibrium, only relative prices matter, and thus the new equilibrium prices have to be scaled at the old price level to make this alternative meaningful.

In addition to correcting national income for the cost of meeting sustainability standards, national income should also be corrected for so-called double counting. Double counting refers to the expenditure on compensatory, restoratory and preventive measures to re-establish or maintain environmental functions, sometimes denoted as defensive measures. According to Hueting and many others, these expenditures wrongly enter national income as value added: loss of environmental functions is not written off, whereas restoration is written up. This line of reasoning can indeed be maintained in case defensive measures are taken in the sphere of consumption, not entering a production process as intermediate input. In our SNI calculations, the cost to reduce dehydration and the clean up of contaminated soils, i.e. the public abatement expenditures, are double counting cases.

2.4 Trend analysis

As already mentioned in Section 2.2, the approach we use to correct net national income for environmental losses is static in nature. This does, however, not exclude the option of calculating SNI for a number of years and analyse the trend of SNI over the years. Moreover, since the sensitivity of the calculated SNI level with respect to various assumptions will be approximately the same for various years, analysing changes in SNI over time, instead of considering the level of SNI for one isolated year, enables us to reduce the sensitivity of our results.

In the present analysis we are interested in the development of SNI between 1990 and 2005. For the years 1990, 1995 and 2000, Hofkes *et al.* (2004) have calculated an SNI indicator, denoted by SNI1990, SNI1995 and SNI2000, respectively. In order to be able to interpret the trend of SNI developments we apply a decomposition analysis. We distinguish four underlying forces of economic development: overall economic growth, changes in the composition of the economy, changes in technologies used for production, and changes in available but unused technologies. These first three forces are commonly referred to as the scale effect, the composition effect and the technique effect. A similar approach can be found in Grossman and Krueger (1993) who apply such a decomposition analysis to interpret the empirical evidence in their influential study of the potential effects of NAFTA on the environment.

In contrast to Grossman and Krueger's study, in this study, changes in actual emissions are not the focus of our analysis. Instead, following Hofkes *et al.* (2004) we study changes in the SNI indicator. The difference in focus has two implications. First, it requires that we add to our decomposition analysis changes to abatement technologies that are available (and essential) for reaching a sustainable economy, but that are not used in the actual situation. We label these technologies “available abatement technologies”. Changes in the SNI indicator that are due to changes in the available abatement technologies are labelled the abatement effect. This implies that the technique effect in our setting measures changes in emission intensities of production over time. Second, we do not use the decomposition to interpret changes in emissions, but changes in the sustainable income level. Recall that the sustainability standards do not change between 1990 and 2005, consequently a decomposition of emission trends in the sustainable economy makes no sense. Instead, we use a parallel approach, comparing changes in the actual economy with associated changes in the sustainable economy that defines the SNI indicator. The scheme of our decomposition analysis is presented in Figure 2.2.

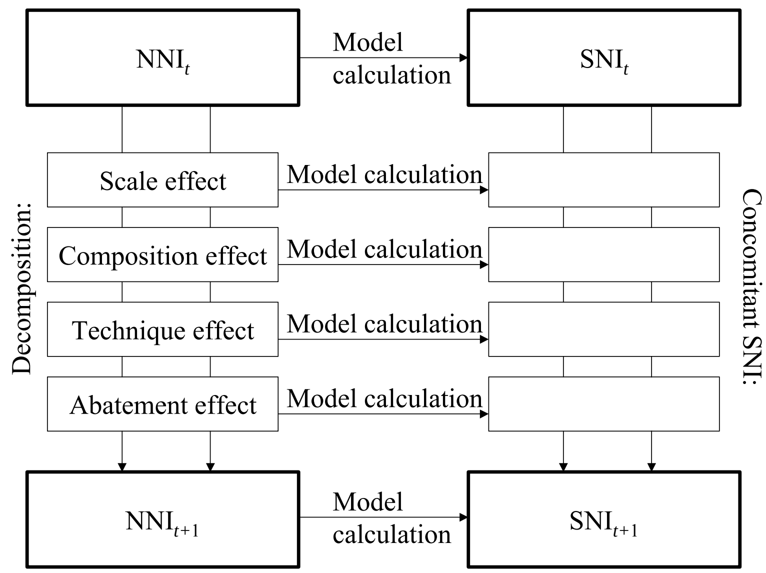

Figure 2.2 Decomposition scheme of national income.

Going from left to right in the figure represents the (standard) calculation of an SNI. Going from top to down represents the trend analysis, moving from t to t+1. Starting from the reference economy in period t, an SNI is calculated by imposing the sustainability standards, which results, through the model calculations, in a (hypothesized) sustainable economy that satisfies the sustainability standards. This procedure is applied to periods of five years, i.e. 1990-1995, 1995-2000 and 2000-2005. The trend analysis for t to t+1 consists of a decomposition of the changes in the reference economy, i.e. we move from BaU at time t (upper left) to BaU at time t+1 (lower left). For each step of the decomposition, we calculate the associated sustainable income levels, i.e. for each step we move in the figure from left to right, applying the standard calculation of an SNI. This results in a concomitant SNI for each step of the decomposition procedure. The resulting breakdown of SNI (from upper right to lower right) is interpreted as a decomposition of the change in SNI between t and t+1.

3. Calibration of the model to 2005

3.1 The Social Accounting Matrix

The model has previously been calibrated for 1990, 1995 and 2000 using historical data for the Netherlands for these years, described in Hofkes *et al*. (2004). For the calculation of Sustainable National Income 2005, CE (2008) has delivered a custom-made social accounting matrix that describes the interlinkages between economic sectors and between economic activity and environmental pressure (emissions). The main data source is the NAMEA accounting system (Keuning, 1993), which captures both the economic and environmental accounts.

Net National Income (NNI) at (current) market prices amounts to 432 billion Euro in 2005, as shown in Table 3.1. As the Consumer Price Index (CPI), as reported by Statistics Netherlands (2008), has risen by 40.7% since 1990, real income has grown by 44% between 1990 and 2005, or 2.5% annually.

Table 3.1 NNI and economic growth in period 1990-2005

Year	NNI in billion Euro (current prices)	NNI in billion Euro (1990 prices)	CPI 1990
1990	213	213	100
1995	268	235	114.0
2000	340	273	124.5
2005	432	307	140.7

To get a feeling for what the economy looks like, we present the condensed Social Accounting Matrix (SAM) in Table 3.2. The row entries represent goods, the column entries represent agents; a positive table entry denotes supply while a negative table entry denotes demand. Market equilibrium requires that supply matches demand. Consequently, rows sum to zero. For all sectors, the value of output equals the value of intermediate deliveries plus the value of production factors employed. Thus, the first five columns also sum to zero. The other column sums represent the trade surplus, X–M (note that a negative value means that exports exceed imports as a negative entry denotes demand for a good), net investments, I, consumption, C, and income from endowments, Y. The latter columns sum to zero according to the standard equation Y=C+I+X–M. To give an example, the value of goods produced by the agricultural sectors amounts to € 20 billion in 2005 (current prices). More than two-thirds thereof, € 13 billion, accounts for the value of intermediate deliveries by other sectors. The remaining € 6 billion is value added.

Table 3.2 Reference Social Accounting Matrix 2005 (billion Euro, current prices).

	Agr.	Ind.	Serv.	Cap.	Abat.	Trade	N.Inv.	Cons.	Endw.	Sum
Agriculture	20	-11	-2	-0		-4		-3		0
Industries	-6	199	-62	-58	-0	-12		-61		0
Services	-4	-70	410	-29	-0	-14		-292		0
Capital	-3	-21	-53	99			-23			0
Abatement		-0			0			-0		0
Labour	-2	-43	-152		-0				197	0
Profits	-4	-33	-84						121	0
Taxes	-0	-22	-58	-11				-23	114	0
Sum	0	0	0	0	0	-30	-23	-379	432	0

3.2 Emission levels and intensities

The environmental data for the historical year 2005 encompass the following environmental themes: the enhanced greenhouse effect, depletion of the ozone layer, acidification, eutrophication, dispersion of toxic substances to water, smog formation, dispersion of fine particles to air, dehydration and soil contamination. The latter two are conceptually different from the other environmental themes, and are not specified on a sectoral basis. Hence, they are not discussed here. Another part of the environmental data are related to the technical measures to reduce the environmental pressure. These will be elaborated in the next section.

The dataset as delivered by CE (2008) contains emission levels per economic sector for individual substances. These are aggregated into the different environmental themes using the conversion factors from Verbruggen (2000), which are represented in Table 3.3. For smog formation and dispersion of fine particles, the emission levels of VOCs and PM10, respectively, are used without conversion.

Table 3.3 Equivalences among substances within environmental themes.

Enhanced greenhouse effect	Depletion of the ozone layer		Acidification	Eutrophication		Dispersion of toxic substances to water	
1000 kg CO_2 =	1 kg CFC 11 =		1 acid equivalent =	1 phosphor equivalent =		1 million kg 1,4-dichlorobezene equivalent =	
27.25 kg		CH_4	46 kg	32.8 kg	NO_2	3.6 kg	mercury
7.04 kg		N_2O	32 kg		SO_2	3.4 kg	cadmium
0.68 kg	1.00 kg	CFC 11	17 kg	12.2 kg	NH_3	666.7 kg	lead
0.23 kg	1.22 kg	CFC 12		1.0 kg	P	55.6 kg	zinc
0.48 kg	1.11 kg	CFC 113		10.0 kg	N	3.2 kg	copper
0.17 kg	1.18 kg	CFC 114				0.3 kg	nickel
0.10 kg	2.50 kg	CFC 115				217.4 kg	chromium
1.54 kg	0.20 kg	halon 1211				6.3 kg	arsenic
0.35 kg	0.08 kg	halon 1301				13.0 kg	PAHs

Table 3.4 presents the emission levels for 2005, aggregated to the different environmental themes. It further relates these to the sustainability standards, which have been taken directly from Hueting and De Boer (2000).

Table 3.4 Base emissions and sustainability standards for the environmental themes in 2005.

Environmental theme	Units	Sustainability standard	Emission level	Relative distance
Greenhouse effect	Billion kg CO_2 equivalents	53.3	245.4	78.3%
Ozone layer depletion	Million kg CFC11 equivalents	0.6	0.1	0
Acidification	Billion acid equivalents	10.0	25.6	60.9%
Eutrophication	Million P-equivalents	128.0	110.9	0
Smog formation	Million kilograms	240.0	180.1	0
Fine particles	Million kilograms	20.0	52.1	61.6%
Dispersion to water	Billion AETP-equivalents	73.5	73.0	0
Dehydration	Percentage affected area	0	100	100%
Soil contamination	Thousands contaminated sites	0	582.7	100%

As can be seen from Table 3.4, the relative distance of the sustainability standard from the historical emission levels, i.e. the relative strictness of the standard, varies widely between the different environmental themes. For the themes Depletion of the ozone layer, Eutrophication, Smog formation and Dispersion to water the emission levels have been steadily decreasing since 1990, and emission levels in 2005 can be considered sustainable. There are a number of persistent environmental problems, however: the (enhanced) greenhouse effect, Acidification, Dispersion of fine particles to air, Dehydration and Soil contamination. For these themes, the distance to target remains large.

Emissions vary widely per sector and per environmental theme. Table 3.5 presents high and low polluting sectors in relative terms. This table gives insight in the pollution intensity of the various sectors. For producers, this intensity is calculated as the pollution in the sector divided by the production quantity; for consumers, the intensity equals pollution divided by total consumption. After the sector name, the table gives pollution factors, which are defined as the pollution intensity of the sector compared to the average pollution intensity of the economy. A factor above unity gives high pollution intensities, a factor below unity means a low pollution intensity. If the factor equals unity, the sector pollutes just as much as could be expected according to its share in total production. Thus, the energy supply sector is almost ten times as polluting as the average economic activity concerning greenhouse gas emissions. Note that the greenhouse effect is the only theme where emission intensities are strictly positive for all sectors, indicating for widely spread greenhouse gas emissions are across the economy.

Table 3.5 High and low polluting sectors for the environmental themes in 2005 in relative terms.

Environmental theme	High polluting sectors (factor* in brackets)	Low polluting sectors (factor* in brackets)
Greenhouse effect	Energy supply (9.6) Agriculture (8.2) Transport by air (7.9)	Commercial services (0.1) Transport equipment ind. (0.1) Machine industry (0.1)
Ozone depletion	Other industries (52.9) Construction (4.3)	all other sectors (0.0)
Acidification	Transport by water (51.2) Agriculture (17.1) Transport by air (8.5)	Transport equipment ind. (0.0) Water supply (0.0) Electrotechnical industry (0.0)
Eutrophication	Agriculture (29.4) Transport by water (9.0) Transport by air (2.3)	Printing industry (0.0) Transport equipment ind. (0.0) Machine industry (0.0)
Smog formation	Other goods and services (12.6) Transport by water (7.1) Metal products industry (3.5)	Electrotechnical industry (0.0) Water supply (0.0) Machine industry (0.0)
Fine particles	Transport by water (33.5) Agriculture (10.9) Basic metals industry (6.0)	Oil and gas extraction (0.0) Transport equipment ind. (0.0) Water supply (0.0)
Dispers. to water	Basic metals industry (17.8) Other mining and quarrying (8.5) Textiles, clothing and leather (8.1)	Energy supply (0.0) Oil and gas extraction (0.0) Transport by air (0.0)

* Pollution intensity calculated as sectoral pollution divided by production quantity for producers; for consumers, the pollution level is divided by consumption total.
Factor calculated as pollution intensity of sector divided by average pollution intensity in economy (per theme).

3.3 Abatement cost curves for environmental themes

According to Hueting's methodology, the correction of the traditional national income figures consists of the costs that have to be incurred to meet the sustainability standards. However, costs of pollution reduction consist of costs of technical measures and costs of volume measures. The costs of technical measures are investment costs (recalculated as annual costs) and operation & maintenance costs of changes in the production process. The costs of volume measures are lost value added, due to a reduction in the production volume. In this section only the costs of technical measures are treated. The list of technical measures is ordered by the cost-effectiveness, i.e. the ratio of emission reduction over abatement costs. Then for each measure, we determine the cumulative reductions of emissions and the cumulative costs. Based on this information, we estimate the abatement cost curves for each environmental theme. These curves are presented in Figure 3.1.

The technical measures are described in detail in a separate report by MNP (2008), and the methodology to estimate abatement cost curves from these technical measures is explained in Verbruggen (2000) and Hofkes *et al*. (2004).

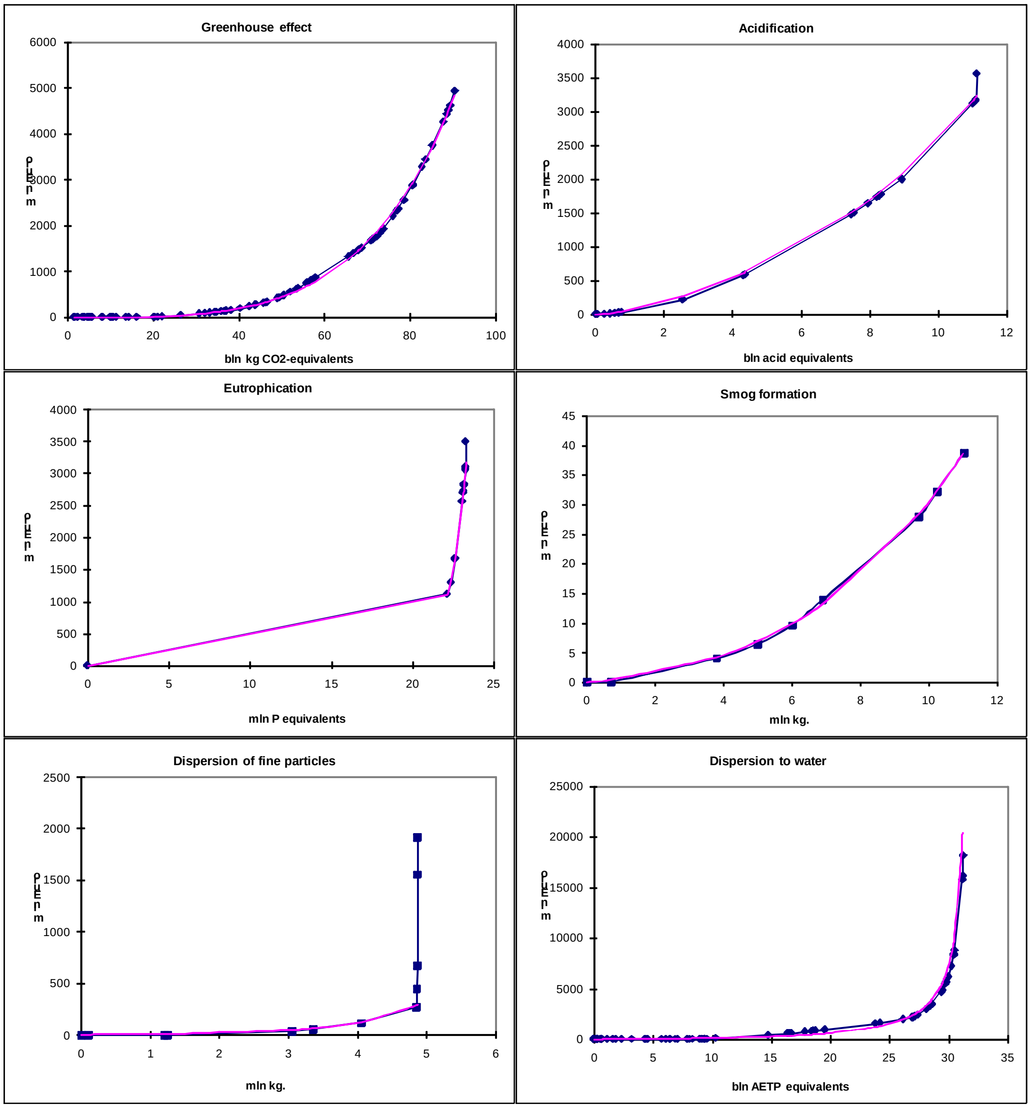

Figure 3.1 Cumulative annual abatement costs as a function cumulative emission reduction (each square represents one measure) and the estimated abatement cost curves per environmental theme.

The abatement cost curve is a constant-elasticity-of-substitution (CES) function of the technical measures. Two essential pieces of information can be derived from these CES functions: the technical potential for reduction, and the CES elasticity. The technical potential describes the total share of emissions that may be reduced through the implementation of technical measures. Any further reductions will have to be realised through volume measures, i.e. by reducing the volume of production and consumption (economic restructuring). The CES elasticity describes the curvature of the abatement cost curve and thereby indicates how quickly abatement costs increase with increasing levels of emission reduction. Table 3.6 shows that for all environmental themes that have a strictly positive distance to target, the technical potential is smaller than the distance to target. This implies that in order to achieve the sustainability standards, economic restructuring is inevitable.

Table 3.6 Characteristics of the estimated abatement cost curves.

Environmental theme	Technical potential	CES elasticity
Greenhouse effect	60.8%	1.457
Ozone depletion	n/a	n/a
Acidification	48.7%	3.123
Eutrophication	22.1%	1.229
Smog formation	15.3%	1.635
Fine particles	11.9%	1.387
Dispersion to water	43.3%	1.149

4. Results: Calculations of SNI 2005

4.1 Sustainable National Income in 2005: two variants

Following the discussion in Chapter 2, we identify the following two Sustainable National Income variants:[4]

- SNI variant 1: Net national income (calculated using the Paasche price index) under sustainability standards assuming *fixed world market prices*, and
- SNI variant 2: Net national income (calculated using the Paasche price index) under sustainability standards assuming *fixed sectoral international trade shares*.

Figure 4.1 presents how national income changes for successive steps of one-tenth of compliance with the sustainability standards. Thus, the left of the figure represents net national income in 2005 without any adjustments for sustainability issues (the base situation), whereas the right reflects a full SNI adjustment (variant 1). For each simulation, the figure shows the break-up of national income per expenditure category. The most noticeable feature of the figure is that national income substantially decreases only after about three-quarters of the sustainability standards are met. In other words, and not unexpectedly, the last quarter of the sustainability standards involves the highest cost and causes the major part of reduction in SNI. The last 10 percent of the sustainability standards is responsible for almost 30 percent of total costs. At this intensity of environmental policy, pollution can only be reduced at very high economic costs. It should be noted, however, that in comparison with SNI calculations for earlier years, the national income loss from the last 10 percent of the sustainability standards is relatively small.

A second observation from Figure 4.1 (and the related numbers in Table 4.1) is that the loss of national income is spread over all expenditure categories. The trade balance (a surplus) decreases in proportion to total national income loss, which is due to the modelling assumption that the trade balance equals a constant share of the savings surplus in national income. Net investments, i.e. investments in excess of replacement investments, decrease with one-third. In the base situation, net investments constitute 5.3% of national income, whereas in SNI variant 1 their contribution is reduced to 4.6%. This can be explained by a reallocation of production from relatively environment-intensive sectors, which are on average also relatively capital-intensive, to cleaner and more labour-intensive sectors, such as services. The lower net investment share in SNI implies that the upward pressure on capital demand stemming from increased abatement activities is more than offset by a fall in capital demand due to this reallocation. This results in a decreasing capital stock.

The consumption of the private households is severely affected in a SNI in absolute terms, but the share of private consumption in SNI variant 1 increases from 60% to 66%. This is the combined effect of a proportional decrease in disposable income levels and the increase in relative prices of the goods consumed by the private household. In contrast, government consumption as share of SNI decreases.

[4] Note that the assumption of fixed import and export shares as made in variant 2 comes closest to Hueting's methodology.

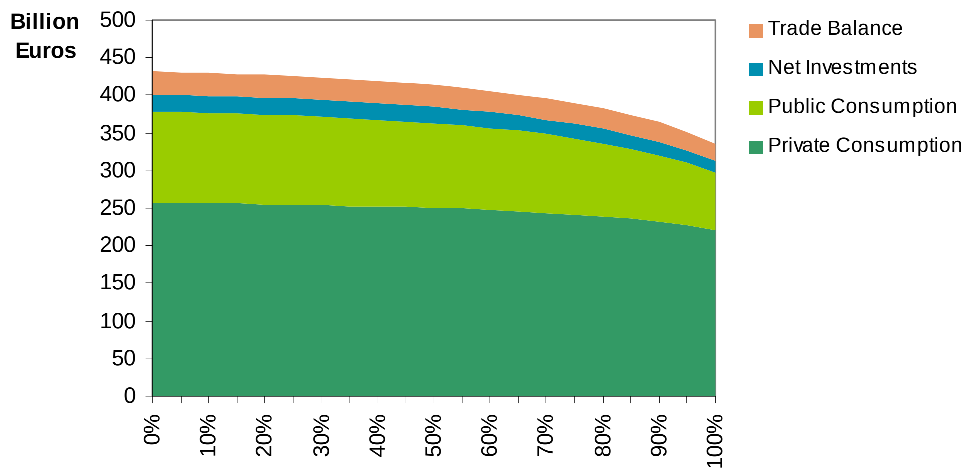

Figure 4.1 The transition path of national income by expenditure category: from NNI (0%) to SNI variant 1 (100%).

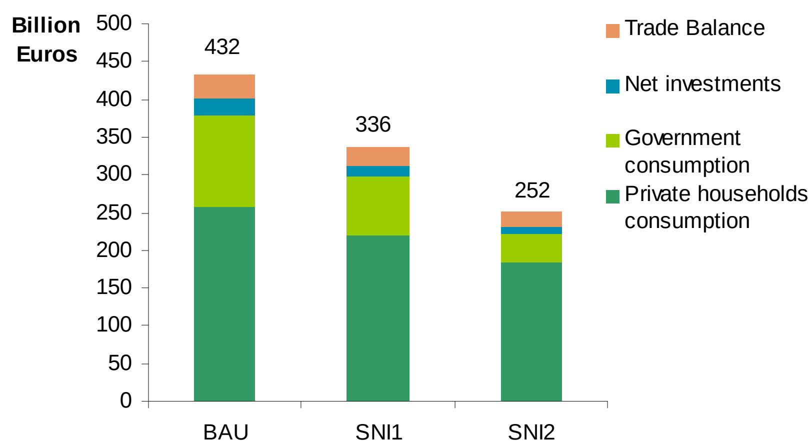

Figure 4.2 Net national income and SNI variants 1 & 2 by expenditure category.

From Figure 4.2, where SNI variants 1 and 2 are compared with national income in the base situation, it becomes clear that variant 2 leads to substantially larger incomes losses than variant 1. Due to the fixed trade shares in SNI variant 2, the possibilities for changing the structure of production are much smaller. As the specification of imports and exports as constant shares in total domestic demand and production leaves no room for an environmentally-extensive specialisation of the Dutch economy, the restructuring of the economy has to be more drastic and, hence, SNI is substantially lower. SNI variants 1 and 2 are € 336 and € 252 billion, respectively. That is 22 and 42 percent lower than net national income. The more severe restructuring of the economy that is required to achieve the sustainability standards in variant 2 comes mostly at the expense of investments and government consumption. Private consumption and the trade balance are also more severely hit than in variant 1, but can expand their share in national income.

These effects can also be seen in Table 4.1, where net national income and the two SNI variants are decomposed into their constituent components. Apart from a break-up of national income by expenditure category (which may be labelled "National Expenditures"), national income can also be decomposed by production factor and national product by contributing sector (using the property that at any moment in time, national income has to equal national product at new equilibrium prices). It has to be recalled that expenditures on so-called defensive measures are not counted as part of SNI (see Section 2.3); in the simulations these include the public expenditures on abatement for dehydration and soil contamination.

The most striking result for the composition of national income in SNI variant 2 is the more than complete greening of the tax system: the government revenues from the sale of pollution rights replace all existing taxes. The excess revenues that arise in case of full compliance to the sustainability standards are redistributed to private households as lump-sum payments. In SNI variant 1, the value of these pollution rights is also substantial, but insufficient to completely replace existing taxes. There are two main mechanisms at work here that govern the greening of the tax system. First, the total value of government expenditures decreases significantly, especially in variant 2. Hence, there are less existing tax revenues to be replaced by the revenues from the sale of the pollution rights. Secondly, since the required reductions in pollution levels are high, the demand for pollution rights substantially exceeds the supply at low permit prices. Like any economic (scarce) good, this puts an upward pressure on the price of the pollution rights. Consequently, high prices for the pollution rights also mean high revenues from the sale of these rights by the government. This latter mechanism is explored in more detail in the discussion on the environmental results below.

From the break-up of national product it can be seen that agricultural production is hit hardest in SNI variant 1. Its share drops from 1.5% in the base situation to 1.2% in SNI1. Part of this decline is due to increased imports of agricultural products, which is facilitated in this variant. Apparently, in this SNI variant there is hardly any room for agricultural production. This situation is completely opposite in variant 2: in this variant there is no room to increase imports of agricultural products, and the necessary goods character of agricultural products implies that it's production cannot decrease too much. But as this production sector is still more polluting than most other production sectors, it will require a substantial amount of emission permits to facilitate it's production level. These permit expenditures are counted as part of national product: they represent value added to the economy by the production sector; analogous to the input of the other production factors labour and capital. Thus, in SNI variant 2 the agricultural sector can substantially increase its share in national product, even though its output is substantially reduced.

The share of industry increases and the share of services declines in both variants. This is partly due to the more necessary character of manufacturing production, expressed by lower income elasticities, compared to services. Put differently, the lower share of services is in line with the lower income level of the SNI. Moreover, in the SNI variants at new equilibrium prices, no compensation takes place in the form of higher prices, as services are generally relatively clean. Finally, the value added generated by expenditures on emission permits is higher for industry than for services. The aggregated category "Other Value Added" incorporates value added generated by the abatement sector (which largely explains the substantial increase in the share of this sector in national product in both SNI variants), but also comprises of taxation on final demand categories and emission permit expenditures by private households. These are all part of total value added generated in the economy, but cannot be attributed to the traditional production sectors (agriculture, industry, services).

Table 4.1 Decomposition of NNI and SNI variants 1 & 2.

Bln Euro (% change w.r.t. NNI)	NNI	SNI1		SNI2	
National Expenditures	**432.2**	**336.5**	**(-22%)**	**251.9**	**(-42%)**
Private households consumption	257.7	220.6	(-14%)	183.9	(-29%)
Government consumption	121.3	76.5	(-37%)	39.0	(-68%)
Net investments	23.0	15.3	(-33%)	7.3	(-68%)
Trade Balance	30.2	24.0	(-20%)	21.7	(-28%)
National Income	**432.2**	**336.5**	**(-22%)**	**251.9**	**(-42%)**
Labour	197.2	141.4	(-28%)	53.9	(-73%)
Capital	120.9	80.6	(-33%)	38.4	(-68%)
Income from Taxes	114.1	55.6	(-51%)	0.0	(-100%)
Emission permits	0.0	72.9		173.5	
Double counting	0.0	-14.0		-13.9	
National Product	**432.2**	**336.5**	**(-22%)**	**251.9**	**(-42%)**
Agricultural Production	6.7	4.0	(-40%)	26.1	(291%)
Industrial Production	98.1	88.5	(-10%)	109.1	(11%)
Services Production	293.6	215.7	(-27%)	94.8	(-68%)
Other value added	33.9	42.3	(25%)	36.0	(6%)
Double counting	0.0	-14.0		-13.9	

A more detailed presentation of these effects can illustrate the mechanisms just described more clearly. National income losses in the SNI variants can be related to losses by production factor and by sector (exploiting the equivalence of national income and national product). This is presented in Table 4.2a. and Table 4.2b. for SNI variants 1 and 2 respectively; negative numbers reflect income losses, positive numbers income gains.

Labour income losses can be attributed mostly to the services sector (€ -43.2 billion), which is not surprising given the labour-intensive nature of these sectors. Capital income losses are more equally spread over industry and services. Tax payments contribute to national income; due to the reduction in tax levels in reaction to the new income from the auctioning of emission permits, and due to the reduced economic activity, national income from taxes is also substantially reduced. The new income from emission permits stems almost completely from permits for greenhouse gas emissions, and a bit to fine particles. This clearly shows that while the sustainability target for acidification may seem large (the required emission reduction is more than 60 percent), these reductions can easily be met as a side-effect of the economic restructuring required to meet the greenhouse gas target. Permit expenditures concentrate in industry and private households.

Table 4.2a. Decomposition of national income changes in billion Euro for SNI variant 1.

		Agri-culture	Indus-try	Ser-vices	Abat. sector	Final dem.	Govern-ment	**Total**
Labour		-2.0	-13.8	-43.2	3.3	0	0	**-55.8**
Capital		-3.6	-16.6	-20.2	0	0	0	**-40.3**
Taxes		-0.4	-11.5	-29.9	0	-16.8	0	**-58.6**
Permits	Greenhouse	2.9	30.1	13.5	0	19.4	0	**65.8**
	Ozone	0	0.1	0	0	0	0	**0.1**
	Acidification	0.0	0.0	0.0	0	0.0	0	**0.0**
	Eutrophication	0.0	0.0	0.0	0	0.0	0	**0.0**
	Smog form.	0.0	0.0	0.0	0	0.0	0	**0.1**
	Fine particles	0.4	2.0	1.9	0	2.4	0	**6.8**
	Dispersion	0.0	0.1	0.0	0	0.0	0	**0.1**
Double counting		0	0	0	0	-0.0	-33.8	**-14.0**
Total		**-2.7**	**-9.6**	**-77.9**	**3.3**	**5.1**	**-14.0**	**-95.7**

Table 4.2b. Decomposition of national income changes in billion Euro for SNI variant 2.

		Agri-culture	Indus-try	Ser-vices	Abat. sector	Final dem.	Govern-ment	**Total**
Labour		-1.8	-30.9	-112.6	1.9	0	0	**-143.3**
Capital		-2.5	-20.3	-59.6	0	0	0	**-82.5**
Taxes		-0.3	-22.4	-57.5	0	-33.8	0	**-114.1**
Permits	Greenhouse	21.3	80.8	27.2	0	30.6	0	**160.0**
	Ozone	0	0.1	0	0	0	0	**0.1**
	Acidification	0.2	0.1	0.2	0	0.1	0	**0.5**
	Eutrophication	0.0	0.0	0.0	0	0.0	0	**0.1**
	Smog form.	0.0	0.0	0.0	0	0.0	0	**0.1**
	Fine particles	2.5	3.5	3.5	0	3.3	0	**12.8**
	Dispersion	0.0	0.1	0.0	0	0.0	0	**0.1**
Double counting		0	0	0	0	0	0	**-13.9**
Total		**19.4**	**11.0**	**-198.8**	**1.9**	**0.2**	**-13.9**	**-180.3**

Clearly, the aggregated nature of the different sectors in Table 4.1 and clouds the more pronounced effects that occur at the individual sectoral level. Figure 4.3 sheds light on these effects by comparing percentage changes in consumption in SNI variants 1 and 2. There are some noteworthy differences between the sectors. These arise from different pollution intensities, substitution possibilities and income elasticities of the various goods and services. The consumption of Oil refineries and the Transport equipment industry is reduced more than average, whereas the consumption of Energy supply, Water supply and Other goods and services decrease less than average. The low consumption loss of energy goods may be surprising, given that it is the sector with the highest pollution intensity for greenhouse gases, but can be explained by the low-income elasticity for energy. The changes in consumption patterns as depicted in Figure 4.3 are less substantial than the changes in production structure, especially for SNI variant 1, which reflects an increased dependence on imports. Furthermore, the sectoral differences between the SNI variants are not that large, given the larger decrease in national income in variant 2. The specification of international trade thus has little impact on the consumption pattern, but primarily affects the overall decrease in consumption levels.

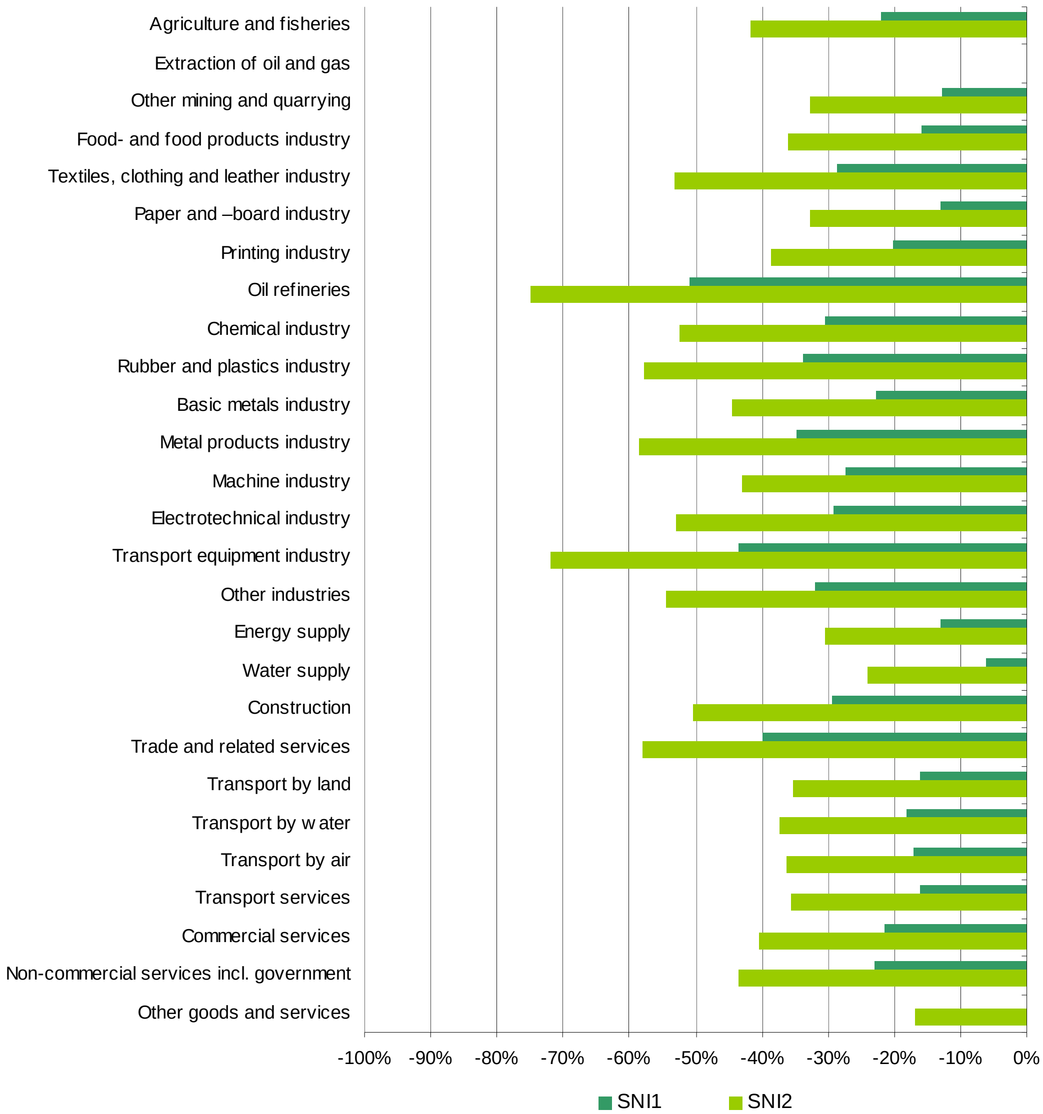

Figure 4.3 Changes in consumption in SNI variants 1 and 2 (percentage change compared to base).

Finally, it is worthwhile to have a further look at the environmental results. The emission levels in the SNI variants are prescribed by the sustainability targets (reproduced in Table 4.3 in the column "Standard"). However, for some environmental themes, the standards are not binding: emission levels are strictly below the standard. This is not surprising for the environmental themes where observed (base) emission levels are below the sustainability standard (Ozone depletion, Eutrophication, Smog formation and Dispersion to water). But it also holds for Acidification in SNI variant 1. This illustrates that the standard for the greenhouse effect is the dominant environmental theme. The large economic restructuring that is required to achieve that standard implies lower emissions for the other themes as well, and for acidification there is no need to implement further restructuring.

Table 4.3 Environmental results: base and SNI variants 1 & 2.

	Emissions				Price of permits (mln €)	
Environmental theme	Base	**Standard**	SNI1	SNI2	SNI1	SNI2
Greenhouse effect	245.4	**53.3**	53.3	53.3	1,235.9	3,003.6
Ozone depletion	0.1	**0.6**	0.1	0.1	0.1	0.2
Acidification	25.6	**10.0**	7.0	10.0	0.1	54.3
Eutrophication	110.9	**128.0**	31.0	43.0	0.1	0.2
Smog formation	180.1	**240.0**	112.7	86.0	0.1	0.2
Fine particles	52.1	**20.0**	20.0	20.0	340.5	638.5
Dispersion to water	73.0	**73.5**	56.9	39.7	0.1	0.2

Note: emission units conform Table 3.4.

The permit prices reflect this effect: the price for greenhouse gas emission permits is much higher than the prices for the other themes (except the price for Ozone depletion, but the very small emission levels for this theme imply that the total expenditures on this theme are very small anyway). Not surprisingly, the permit prices are larger in variant 2 than in variant 1. Note that a permit price of € 1,236 million per billion kg CO_2 equivalents, or € 1,236 /ton CO_2-eq., is well above the figures normally found in the literature. Apart from the obvious explanation that the required emission reduction is larger than mostly analysed, another explanation for the high greenhouse gas permit price can be found by comparing the required emission reduction for greenhouse gases with the amount of emissions that can be avoided through technical measures: the required reduction equals 78 percent, while only about 60 percent can be reduced by means of technical measures (cf. Section 3.3). Consequently, costly volume measures (economic restructuring) have to be taken to reduce greenhouse gas emissions sufficiently. In contrast to most models, we assume that there is an absolute upper limit on the availability of technical measures, and further reductions will have to be achieved through a restructuring of the economy.

4.2 A trend analysis

The results for the SNI calculations for 2005 can be related to similar calculations for earlier years (cf. Hofkes *et al.*, 2004). Figure 4.4 shows the development of net national income and the SNI levels for the two variants. The numbers for 2005 have been deflated to constant 1990 level using the development of the Consumer Price Index; the price development between 1990 and 2005 has been 40.7 percent (cf. Table 3.1), implying that the 2005 net national income (NNI) of € 432.2 billion in current prices equals € 307.2 billion at constant 1990 prices. The associated numbers are given in Table 4.4.

Several observations can be drawn from the figure and table. First, it is clear that the growth in national income has been quite steady over the last fifteen years: in the period 2000-2005 the average annual growth rate of NNI has been 2.4 percent, and since 1990 been on average 2.5 percent. Obviously, there may be a business-cycle effect within the period that is obscured in the analysis of 5-year periods.

Secondly, in both variants sustainable national income grows with the (unsustainable) net national income. That implies the overdependence of the Dutch economy on natural resource exploitation has not increased. The underlying factors for this result are investigated in detail in the decomposition analysis below.

The development of absolute emission levels shown in Table 4.4 reveals that the decoupling of economic growth and environmental pressure has continued between 2000 and 2005: for all environmental themes, emission levels have reduced.

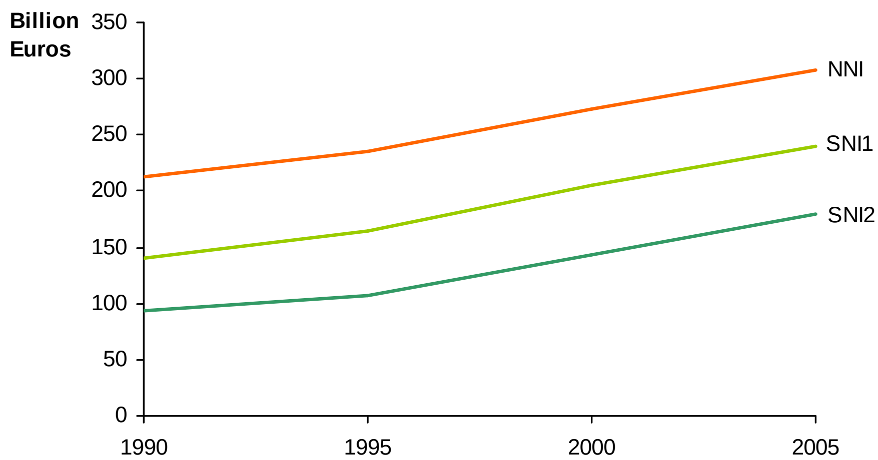

Figure 4.4 Development of NNI and SNI variants 1 and 2 (constant 1990 prices).

Table 4.4 Development of NNI and SNI variants 1 & 2 (at constant 1990 prices) and emissions.

	1990	1995	2000	2005
Absolute values (bln Euro)				
NNI	213	235	273	307
SNI1	140	164	205	239
SNI2	94	107	143	179
Absolute gap (bln Euro)				
SNI1	73	72	69	68
SNI2	119	128	131	128
Percentage gap				
SNI1	34%	30%	25%	22%
SNI2	56%	54%	48%	42%
Emission levels (base; units conform Table 3.4)				
Greenhouse effect	254.5	246.9	248.3	245.4
Ozone depletion	10.4	0.3	0.1	0.1
Acidification	40.1	34.0	31.3	25.6
Eutrophication	188.9	173.9	137.5	110.9
Smog formation	527.1	385.5	280.3	180.1
Fine particles	78.6	59.2	53.2	52.1
Dispersion to water	196.8	99.6	88.3	73.0

As explained in Section 2.4, the development of national income for the base and SNI variants can be decomposed into four driving forces: a scale effect, a composition effect, a technique effect and an abatement effect. The results are shown in Table 4.5. It should be noted that the calculation of each of these effects requires a new simulation, and cannot be derived directly from the observed data or the main model calculations for 2005.

Table 4.5 Decomposition analysis: development of NNI and SNI variants 1 & 2 between 1990 and 2005 (billion Euros, 1990 prices).

	NNI	(% change)	SNI1	(% change)	SNI2	(% change)
1990	**213**		**140**		**94**	
Scale effect	235	(+10.5%)	149	(+6.4%)	97	(+2.6%)
Composition effect	235		151	(+1.7%)	99	(+2.7%)
Technique effect	235		164	(+8.5%)	108	(+8.7%)
Abatement effect	235		164	(-0.2%)	107	(-0.6%)
1995	**235**	**(+10.5%)**	**164**	**(+17.2%)**	**107**	**(+13.8%)**
Scale effect	273	(+16.0%)	177	(+8.1%)	109	(+1.3%)
Composition effect	273		186	(+4.7%)	111	(+2.5%)
Technique effect	273		196	(+5.8%)	128	(+15.0%)
Abatement effect	273		205	(+4.3%)	141	(+10.2%)
2000	**273**	**(+16.0%)**	**205**	**(+24.9%)**	**141**	**(+31.5%)**
Scale effect	307	(+12.5%)	221	(+7.8%)	142	(+0.9%)
Composition effect	307		221	(+0.2%)	136	(-4.2%)
Technique effect	307		232	(+5.1%)	156	(+14.4%)
Abatement effect	307		239	(+2.9%)	179	(+14.7%)
2005	**307**	**(+12.5%)**	**239**	**(+16.9%)**	**179**	**(+26.9%)**

As a first step, the results for 2000 have been rescaled for 2005 prices, using the development of the Consumer Price Index, to make the results comparable with the calculations for 2005. Next, the scale effect is introduced by enlarging all elements in the economy with the observed growth in NNI between 2000 and 2005 (at constant 2005 prices). The scale effect substantially increases the level of SNI for both variants 1 and 2, but these effects are smaller than for NNI. The reason is that the emission levels are higher, as the volume of economic activity increases and no efficiency improvements in the use of environmental resources are assumed. The higher emission levels in turn imply that the distance to the sustainability standard becomes larger. Thus more technical and volume measures are needed to achieve the standards, and the associated costs take away part of the income gain from the scale effect. Nonetheless, the scale effect is still positive for both variants, albeit very small for variant 2.

For NNI, by definition only the scale effect affects total national income; for the SNI variants, the other effects can also have an impact on the total national income, as these are the results of new model calculations, in which some of the characteristics are changed. The composition effect reflects the changes in the sectoral structure of the economy between 2000 and 2005. In most cases, this implies a shift from labour income to capital and tax income with a positive net effect, but for SNI variant 2 the negative development of labour income between 2000 and 2005 is not compensated by higher capital and tax income. Thus, in variant 2, where a specialisation of the domestic economy in environmentally friendly products cannot occur, the composition effect makes it harder to achieve the sustainability standards.

The technique effect measures the influence of changes in the production techniques that are employed. These changes are reflected in the changes in emission intensities of the different economic activities (note that changes in abatement technologies are measured by the abatement effect). For both SNI variant 1 and 2 and for all periods the technique effect is strong and positive, implying that the growth in economic activity between 1990 and 2005 has been accompanied by substantial efficiency improvements in the use of environmental resources. The effect is largest for variant 2, where the value of an improvement in emission intensity is largest (as the sustainability standards are relatively more stringent in that variant). The large positive technique effect in variant 2 more than overcomes the negative composition effect.

Finally, improvements in the availability of technical measures are shown by the abatement effect. Between 1990 and 1995 this effect is measured to be negative for both SNI variant 1 and 2, reflecting that the emission intensity improvements as measured by the technique effect have partially depleted the options for further improvements. For the later periods, the effect is, however, positive. Rather than a movement along the marginal abatement cost curve, there has been a shift of the curve since 1995: new technical measures have been identified that allow for relatively cheap emission reductions in the transition towards a sustainable national income. As the relative stringency of the standards is strongest in variant 2, it is not surprising that the abatement effect is largest in this variant.

Clearly, for each calculation, a break-up of national income by expenditure category is also available. This is reflected by the constituent parts of the columns in Figure 4.5, expressed in 2005 prices to ease comparison with the results in the previous section. Note that environmental income, i.e. income from emission permits, is zero by definition in the base NNI. For SNI variant 1 the composition effect implies a shift from labour income to capital and tax income with a negligible net effect, but for SNI variant 2 the negative impact on labour income is not compensated by higher capital and tax income. In other words, the restructuring of the economy as took place between 2000 and 2005 made it more difficult for the economy to become sustainable (at least in variant 2). Not surprisingly, the technique and abatement effects have less pronounced effects on the composition of national income by expenditure category.

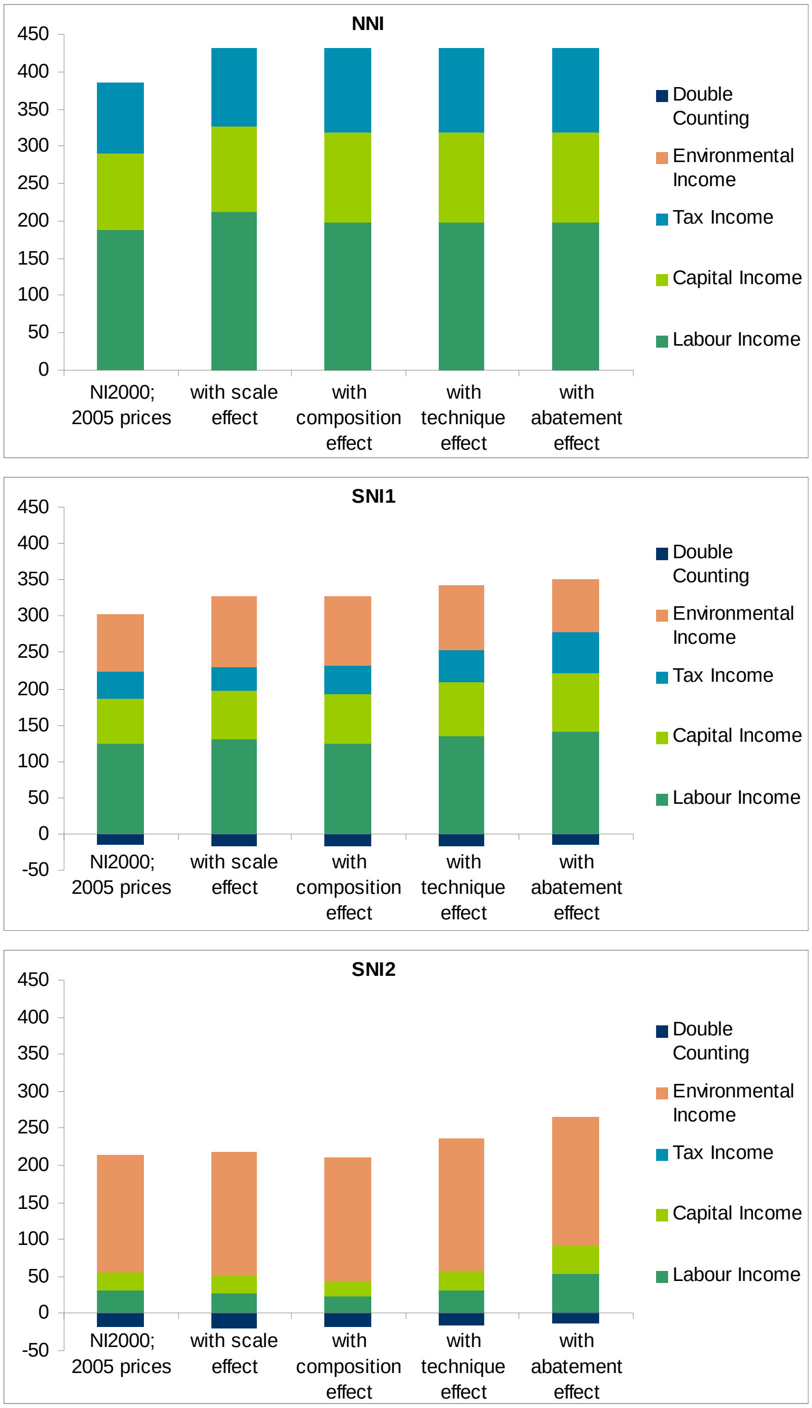

Figure 4.5 Decomposition of the development of NNI and SNI variants 1 and 2 between 2000 and 2005 (billion Euros; 2005 prices).

Summarising, the increase in sustainable national income between 2000 and 2005 can in variant 1 be attributed mostly to the scale effect: of the total increase of 16.8 percent, almost 8 percent-points stem from the scale effect; the technique and abatement effects contribute another 5.5 and 3.3 percent-points, respectively, while the composition effect was negligible (0.2 percent-points). For SNI variant 2, by far the largest part of the increase of 27.5 percent stem from the technique effect (14.0 percent-points) and the abatement effect (16.4 percent-points), and much less from the scale effect (1.4 percent-points), but these effects are partially compensated by the negative composition effect (-4.3 percent-points).

4.3 Sensitivity analysis

4.3.1 Results for the Laspeyres price index

Although national income tries to capture the volume of economic activity, it is unavoidable to use prices in the calculations. In Section 2.3, it was argued that the use of the Paasche index is most appropriate, but there is an alternative: the Laspeyres price index. The use of the Laspeyres price index prescribes that all aggregate results are calculated using the prices in the old equilibrium. It is important to realise that using a different price index does not affect the model simulation as such, but only the calculation of aggregate information on the economy, including national income. Table 4.6 reports the decomposition of NNI and the two SNI variants, using Laspeyres prices. The table the use of an alternative set of prices is of minor importance for national income. But the use of different prices affects the composition of national income in a non-negligible way. The different price index has the largest impact on the income from the environment: in the Paasche index, the very high new equilibrium price for emission permits is used, whereas the value of permits using old prices results is an environmental income of virtually zero. This is however compensated by higher income from the other sources, especially labour. An alternative perspective on these numbers is that at old prices, all components of national income decrease roughly proportionately, while at new prices there are substantial shift between income categories.

Table 4.6 Decomposition of NNI and SNI variants 1 & 2 using Laspeyres prices.

Bln Euro (% change w.r.t. NNI)	NNI	SNI1		SNI2	
National Expenditures	**432.2**	**363.1**	**(-16%)**	**263.6**	**(-39%)**
Private households consumption	257.7	228.5	(-11%)	170.6	(-34%)
Government consumption	121.3	92.9	(-23%)	67.8	(-44%)
Net investments	23.0	17.9	(-22%)	11.5	(-50%)
Trade Balance	30.2	23.8	(-21%)	13.7	(-55%)
National Income	**432.2**	**344.0**	**(-20%)**	**244.9**	**(-43%)**
Labour	197.2	197.2	(0%)	197.2	(0%)
Capital	120.9	94.1	(-22%)	60.7	(-50%)
Income from Taxes	114.1	65.6	(-42%)	0.0	(-100%)
Emission permits	0.0	0.5		0.4	
Double counting	0.0	-13.4		-13.4	
National Product	**432.2**	**380.5**	**(-12%)**	**250.6**	**(-42%)**
Agricultural Production	6.7	0.4	(-93%)	0.0	(-99%)
Industrial Production	98.1	67.2	(-31%)	47.3	(-52%)
Services Production	293.6	274.3	(-7%)	185.2	(-37%)
Other value added	33.9	52.0	(53%)	31.5	(-7%)
Double counting	0.0	-13.4		-13.4	

4.3.2 Results for re-allocated emissions

Emissions can be linked to the inputs of intermediates and the specific consumption patterns, instead of being linked to the output of a sector and the aggregate consumption level, with the help of an econometric approximation as described in Verbruggen (2000).

Table 4.7 shows for five environmental themes the resulting reallocation of emissions. This table shows, for instance, that greenhouse gas emissions are much more attributed to energy supplying sectors, such as Oil and gas extraction and Energy supply, while large scale energy users, such as the Chemical industry and consumers, have lower attributed emissions.

Table 4.7 Absolute changes in the sectoral allocation of emissions when emissions are attributed to intermediate deliveries and consumption patterns, 2000.

	Green-house effect	Acidifi-cation	Eutro-phication	Smog formation	Fine particles
Agriculture	-3.1	0.0	-0.4	-1.4	2.2
Oil and gas extraction	19.4	2.1	0.7	2.1	0.1
Other mining	7.1	0.0	0.0	0.0	1.6
Food-related industry	6.3	0.2	3.4	12.7	0.3
Textile- and leather industry	0.9	0.0	1.2	3.1	0.7
Paper and –board industry	-0.1	0.0	0.0	-0.1	0.0
Printing industry	-0.3	0.0	0.0	0.0	0.0
Oil refineries	-4.3	-1.3	-0.4	-1.3	-0.1
Chemical industry	-5.7	-0.2	-0.2	-0.5	-0.2
Rubber and plastics industry	-0.3	0.0	0.0	0.0	0.0
Basic metals industry	-1.6	0.0	0.0	0.0	-0.3
Metal products industry	-0.4	0.0	0.0	0.0	0.0
Machine industry	-0.3	0.0	0.0	-0.1	0.0
Electrotechnical industry	-0.5	0.0	0.0	-0.1	0.0
Transport equipment industry	-0.1	0.0	0.0	10.3	0.0
Other industries	-2.0	0.0	-0.1	-0.2	-0.4
Energy supply	18.4	-0.5	-0.2	-0.5	-0.4
Water supply	-0.1	0.0	0.0	0.0	0.0
Construction	-2.2	0.0	0.0	-0.2	-0.4
Trade and related	-4.8	-0.3	-0.4	-9.8	-0.4
Transport by land	-1.1	0.0	0.0	-0.5	0.0
Transport by water	-0.3	0.3	0.0	7.2	0.0
Transport by air	-0.5	0.0	0.0	-2.1	2.0
Transport services	-0.3	0.1	0.0	5.5	-0.8
Commercial services	0.7	0.0	-0.1	-0.7	-0.3
Non-commercial services	-0.3	0.0	-0.2	-1.4	0.4
Other goods and services	0.3	0.0	-0.1	-0.2	0.0
Subsistence consumer	-15.6	-0.3	-2.0	-10.4	-2.3
Private consumer	-9.2	-0.1	-1.3	-11.5	-1.5
Ratio of reallocated emissions (R_e)	0.39	0.14	0.06	0.33	0.23

Note: There are no significant changes in emissions for depletion of the ozone layer and dispersion to water.

Note: Units conform Table 3.4.

The results of the SNI model simulations using the re-allocated emissions are given in Table 4.8. Comparing these results to Table 4.1 reveals that the effects of the re-allocation of emissions are substantial. Under variant 1, with constant relative prices on the world market, the reallocation of emissions increases income by € 16 billion; the decrease in income moves from a 22 % decline in the base calculations (cf. Table 4.1) to an 18 % decline. Under variant 2, with constant shares of exports and imports, the effect is smaller. Now, reallocated emissions increases income by €10 billion; compared to the reference ‘business as usual’, income moves from a 42% decline to a 39% decline.

There is no simple explanation for the increase in income that is reached by reallocating emissions. Our analysis points to an increased flexibility of the economy to cope with sustainability standards, as the main cause for the increase in sustainable income. An analysis of the distribution of emissions over the economy shows that the distribution becomes more concentrated (skewed) after the reallocation of emissions. Emissions are reallocated towards the sectors that were already pollution intensive, and away from sectors that were already pollution extensive. As a result, the economy can be more discriminating in its choice of sectors that shrink when the economy has to meet the sustainability standards. This argument also explains why the increase in sustainable income is more pronounced under variant 1 then under variant 2. Under variant 2, there are fewer opportunities for the economic to decrease economic activity in specific polluting sectors, and thus, a more skewed distribution of emissions has a smaller impact.

Table 4.8 Decomposition of NNI and SNI variants 1 & 2 using re-allocated emissions.

Bln Euro (% change w.r.t. NNI)	NNI	SNI1		SNI2	
National Expenditures	**432.2**	**352.7**	**(-18%)**	**261.9**	**(-39%)**
Private households consumption	257.7	223.3	(-13%)	189.8	(-26%)
Government consumption	121.3	86.9	(-28%)	44.9	(-63%)
Net investments	23.0	16.8	(-27%)	7.9	(-66%)
Trade Balance	30.2	25.6	(-15%)	19.2	(-36%)
National Income	**432.2**	**352.7**	**(-18%)**	**261.9**	**(-39%)**
Labour	197.2	156.2	(-21%)	60.4	(-69%)
Capital	120.9	88.3	(-27%)	41.7	(-66%)
Income from Taxes	114.1	77.1	(-32%)	0.0	(-100%)
Emission permits	0.0	45.6		178.4	
Double counting	0.0	-14.6		-18.7	
National Product	**432.2**	**352.7**	**(-18%)**	**261.9**	**(-39%)**
Agricultural Production	6.7	4.6	(-31%)	25.6	(284%)
Industrial Production	98.1	92.7	(-5%)	143.9	(47%)
Services Production	293.6	237.6	(-19%)	98.4	(-66%)
Other value added	33.9	32.3	(-5%)	12.6	(-63%)
Double counting	0.0	-14.6		-18.7	

4.3.3 Results for a less stringent target for the Greenhouse effect

In the base calculations, by far the most stringent environmental theme is the Greenhouse effect. The sustainability standard prescribes emission reductions of 78.2 percent, much more than current European policy targets. Therefore, it is worthwhile to investigate an alternative scenario where the required emission reductions for greenhouse gases equal 50 percent. As the less stringent target cannot be labelled as sustainable according to Hueting's methodology, we adopt the more general term Green National Income (GNI) for this alternative scenario.

Table 4.9 shows the decomposition of national income when using this less stringent target for the Greenhouse effect. Both GNI variants are substantially higher than in the base simulations, in absolute terms € 25 billion and almost € 14 billion for variants 1 and 2, respectively. These results indicate that while the marginal costs of the greenhouse target are high, but the more lenient target still requires substantial adjustments in the economy, as the less stringent greenhouse effect target implies that the relative strictness of the other environmental themes increases: emissions of these pollutants are no longer a costless side-effect of climate policy. From the decomposition of national product it becomes clear that the less stringent GHG target is especially favourable for the services sectors, whereas the impact on the other sectors is minor.

Table 4.9 Decomposition of NNI and GNI variants 1 & 2 using a less stringent target for the Greenhouse effect (-50%).

Bln Euro (% change w.r.t. NNI)	NNI	GNI1		GNI2	
National Expenditures	**432.2**	**361.6**	**(-16%)**	**265.6**	**(-39%)**
Private households consumption	257.7	233.5	(-9%)	196.3	(-24%)
Government consumption	121.3	85.5	(-30%)	40.1	(-67%)
Net investments	23.0	17.2	(-25%)	8.0	(-65%)
Trade Balance	30.2	25.4	(-16%)	21.2	(-30%)
National Income	**432.2**	**361.6**	**(-16%)**	**265.6**	**(-39%)**
Labour	197.2	150.5	(-24%)	53.9	(-73%)
Capital	120.9	90.5	(-25%)	42.1	(-65%)
Income from Taxes	114.1	59.0	(-48%)	0.0	(-100%)
Emission permits	0.0	73.7		178.0	
Double counting	0.0	-12.0		-8.4	
National Product	**432.2**	**361.6**	**(-16%)**	**265.6**	**(-39%)**
Agricultural Production	6.7	4.6	(-31%)	38.1	(471%)
Industrial Production	98.1	85.5	(-13%)	69.9	(-29%)
Services Production	293.6	235.1	(-20%)	117.0	(-60%)
Other value added	33.9	48.5	(43%)	49.1	(45%)
Double counting	0.0	-12.0		-8.4	

Table 4.10 disaggregates the national income from emission permits by environmental theme, for both GNI variants, and for the base calculations and the calculations with the less stringent greenhouse effect target. It clearly shows that the role of the Greenhouse effect is taken over by Dispersion of fine particles as the dominant environmental theme. The permit prices of this theme soar high when the less stringent target for the greenhouse effect is implemented, and prevent a big increase in national income. Thus, many elements of the economic restructuring, especially in industry, that were necessary to achieve the greenhouse target are now required to achieve the fine particles target.

Table 4.10 Decomposition of environmental permit income for variants 1 & 2 for the base simulations and a less stringent target for the Greenhouse effect (-50%).

	Base simulation		Less stringent GHG target	
Bln Euro	SNI1	SNI2	GNI1	GNI2
Greenhouse effect	65.8	160.0	1.2	0.1
Ozone depletion	0.1	0.1	0.1	0.0
Acidification	0.0	0.5	0.0	0.7
Eutrophication	0.0	0.1	0.0	0.1
Smog formation	0.1	0.1	0.1	0.1
Fine particles	6.8	12.8	72.2	177.0
Dispersion to water	0.1	0.1	0.1	0.1
Total	**72.9**	**173.5**	**73.7**	**178.0**

4.3.4 Results for changed sustainability standards

For some environmental themes such as the enhanced greenhouse effect, it is still uncertain, from a natural scientist's point of view, which current level of emissions can be considered sustainable. To have a basic understanding of the implications of this uncertainty, we have calculated the SNI levels for different sustainability standards that were weaker and stronger than the standards used in the base simulations, respectively. Table 4.11 shows the results for variants 1 and 2.

Table 4.11 Decomposition of NNI and SNI variants 1 & 2 using different sustainability targets.

	NNI	SNI1			SNI2		
Bln Euro (% change w.r.t. NNI)		Base	10% less strict	10% more strict	Base	10% less strict	10% more strict
National Expenditures	**432.2**	**336.5**	**346.1**	**324.7**	**251.9**	**271.9**	**231.2**
Private households cons.	257.7	220.6	224.4	215.9	183.9	198.8	171.6
Government cons.	121.3	76.5	81.1	71.1	39.0	45.2	34.5
Net investments	23.0	15.3	16.1	14.4	7.3	8.5	6.2
Trade Balance	30.2	24.0	24.5	23.2	21.7	19.4	18.9
National Income	**432.2**	**336.5**	**346.1**	**324.7**	**251.9**	**271.9**	**231.2**
Labour	197.2	141.4	147.8	133.3	53.9	66.8	42.7
Capital	120.9	80.6	84.4	75.9	38.4	44.7	32.8
Income from Taxes	114.1	55.6	62.3	47.3	0.0	0.0	0.0
Emission permits	0.0	72.9	65.5	82.0	173.5	174.5	169.7
Double counting	0.0	-14.0	-14.0	-13.9	-13.9	-14.1	-14.1
National Product	**432.2**	**336.5**	**346.1**	**324.7**	**251.9**	**271.9**	**231.2**
Agricultural Production	6.7	4.0	4.4	3.4	26.1	26.7	24.9
Industrial Production	98.1	88.5	90.0	86.4	109.1	113.8	103.5
Services Production	293.6	215.7	224.6	204.7	94.8	109.0	81.8
Other value added	33.9	42.3	41.1	44.0	36.0	36.4	35.0
Double counting	0.0	-14.0	-14.0	-13.9	-13.9	-14.1	-14.1

The SNI-level seems to be almost proportional to the level of emissions allowed under the sustainability standards. This almost linear relation also applies to the case where the environmental standard is decreased. This is intuitive for variant 2 since, at the sustainable state, the economy has used most of its flexible options to achieve the required emission reductions. The only option left to reduce emissions even further is by applying a uniform reduction of all economic production activities: 10 percent less (more) strict targets increase (decrease) the SNI2 with € 20 billion.

For variant 1 there is some non-linearity in the results, however. Table 4.11 shows for variant 1 that more strict targets decrease SNI more than that less strict targets increase SNI (€ 9.6 billion and € 11.8 billion, respectively). The explanation is that, apparently, more substitution possibilities are still open and no uniform reduction of economic activities is required. Obviously, the more stringent the targets, the higher their marginal costs. The results of this excercise for the SNI indicators in 2005 largely correspond to the findings for 2000 and 1995 (Hofkes *et al*., 2004; 2002). The relationship between sustainability standards and SNI is almost linear in particular for variant 2, and the relative changes in SNI variant 2 are substantially larger than for SNI variant 1.

5. Final remarks

In this study, we calculated a Sustainable National Income (SNI) according to Hueting's methodology for the Netherlands in 2005. We find for both distinguished variants that the level of SNI remains substantially below the level of Net National Income (NNI): SNI variants 1 and 2 are € 336 and € 252 billion, respectively. That is 22 and 42 percent lower than net national income (which equalled € 432 billion).

The growth in NNI between 2000 and 2005 has, however, been accompanied by a similar growth in SNI. The increase in SNI over the last five years can largely be attributed to the scale effect for SNI variant 1 and to the technique and abatement effects for variant 2.

It should be stressed that the levels of SNI as reported here are the result of model simulations, and cannot be derived from statistics directly. This implies that the level of SNI is sensitive to the model assumptions. Furthermore, the problems in establishing the sustainability standards that are used to prescribe the targets for emissions continue to be subject of debate. Notwithstanding these qualifications, the results reported here reflect the best available estimate of Hueting's Sustainable National Income for 2005.

Literature references

CE (2008). Social Accounting Matrix for the calculation of a Sustainable National Income 2005, Delft.

Dellink, R., Gerlagh, R. & Hofkes, M.W. (2001). *Calibration of the applied general equilibrium model for the Netherlands in 1990*. IVM report (W-01/17). Vrije Universiteit, Amsterdam, the Netherlands.

Gerlagh, R., Dellink R.B., Hofkes, M.W. & Verbruggen, H. (2001). *An applied general equilibrium model to calculate a Sustainable National Income for the Netherlands*. IVM report (W-01/16). Vrije Universiteit, Amsterdam, the Netherlands.

Gerlagh, R., Dellink, R.B., Hofkes, M.W. & Verbruggen, H. (2002). A Measure of Sustainable National Income for the Netherlands. *Ecological Economics*, *41*, 157-174.

Grossman, G.M. & Krueger, A.B. (1993). Environmental Impacts of a North American Free Trade Agreement. In: Garber, P.M. (ed.), *The Mexico-U.S. free trade agreement*. (pp. 13-56). Cambridge and London: MIT Press.

Hofkes, M.W., Gerlagh, R., Lise, W. & Verbruggen, H. (2002). *Sustainable National Income: A trend analysis for the Netherlands for 1990-1995*. IVM report (R-02/02). Vrije Universiteit, Amsterdam, 53 pp.

Hofkes, M.W., Gerlagh, R. & Linderhof, V. (2004). *Sustainable National Income: a trend analysis for the Netherlands for 1990-2000*. IVM report (R-04/02). Vrije Universiteit, Amsterdam.

Hueting, R. (1974). *New Scarcity and Economic Growth*. Amsterdam: Agon Elsevier.

Hueting, R. (1992). Correcting National Income for Environmental Losses: a Practical Solution for a Theoretical Dilemma. In: Krabbe, J.J. & Heijman, W.J.M. (eds), *National Income and Nature: Externalities, Growth and Steady State*. Dordrecht/Boston/London: Kluwer Academic Publishers.

Hueting R. (1995). Estimating sustainable national income. In Dieren, W. van. (ed.), *Taking nature into account; towards a sustainable national income* (Ch. 13). New York: Springer-Verlag.

Hueting, R. & Boer, B. de (2000). *Environmental valuation and sustainable national income according to Hueting*. In: Verbruggen, H. (ed.) (Chapter 3). Final report on calculations of a sustainable national income according to Hueting's methodology, Report number IVM-O-00/10, Vrije Universiteit, Amsterdam.

Hueting, R. & Reijnders, L. (1998). Sustainability is an Objective Concept. *Ecological Economics*, *27*, 139-147.

Keuning, S.J. (1993). An information system for environmental indicators in relation to the national accounts. In: Vries, W.F.M. de (ed.), *The value added of national accounting*. Statistics Netherlands, The Hague: SDU Publishers.

MNP (2008). Abatement cost data for the calculation of a Sustainable National Income 2005, Bilthoven.

Statistics Netherlands (2008). Consumer Prices Index, statline.cbs.nl.

UN, United Nations (1993a). *Integrated environmental and economic accounting*. United Nations Statistics Division, New York.

UN, United Nations (1993b). *System of National Accounts: Handbook on National Accounting*, United Nation Statistics Division, New York.

Verbruggen, H., ed., (2000). Final report on calculations of a sustainable national income according to Hueting's methodology. Report number IVM-O-00/10, Vrije Universiteit, Amsterdam.

Verbruggen, H., Dellink R.B., Gerlagh R., Hofkes M.W. & Jansen, H.M.A. (2001). Alternative calculations of a sustainable national income for the Netherlands according to Hueting. In Ierland, E. C. van, Straaten, J. van der & Vollebergh, H.R.J. (Editors), *Economic Growth and Valuation of the Environment*. (pp. 275-312). Cheltenham, UK: Edward Elgar.

Appendix: Tables with detailed results of the simulations

Table A.1 Reference Social Accounting Matrix 2005 (billion Euro, current prices) with emission accounts.

	Agr.	Ind.	Serv.	Cap.	Abat.	Trade	N.Inv.	Cons.	Endw.	Sum
Agriculture	20	-11	-2	-0		-4		-3		0
Industries	-6	199	-62	-58	-0	-12		-61		0
Services	-4	-70	410	-29	-0	-14		-292		0
Capital	-3	-21	-53	99			-23			0
Abatement		-0			0			-0		0
Labour	-2	-43	-152		-0				197	0
Profits	-4	-33	-84						121	0
Taxes	-0	-22	-58	-11				-23	114	0
Sum	0	0	0	0	0	-30	-23	-379	432	0
Greenh.	39.1	118.1	47.3					41.0		245.4
Ozone		0.1								0.1
Acid.	8.4	4.6	10.6					2.0		25.6
Eutro.	62.8	13.9	10.2					24.0		110.9
Smog.	4.9	68.5	35.4					71.2		180.1
PM10	11.0	14.0	16.7					10.4		52.1
Dispers.	0.5	51.8	5.8					14.9		73.0

Table A.2 Sustainable National Income (variant 1) expressed as a Social Accounting Matrix 2005 (billion Euro, current prices) with emission accounts.

	Agr.	Ind.	Serv.	Cap.	Abat.	Trade	N.Inv.	Cons.	Endw.	Sum
Agriculture	6	-8	-2	-1		9		-4		0
Industries	-1	153	-50	-41	-14	19		-66		0
Services		-41	310	-19	-7	-52		-190		0
Capital		-10	-40	66			-15			0
Abatement		-5	-2		24			-17		0
Labour		-29	-109		-3				141	0
Profits		-16	-64						81	0
Taxes		-11	-28	-5				-12	56	0
Greenh..	-3	-30	-13					-19	66	0
Ozone										0
Acid.										0
Eutro.										0
Smog.										0
PM10		-2	-2					-2	7	0
Dispers.										0
Publ. abat.								14	-14	0
Sum	0	0	0	-0	0	-24	-15	-296	336	0
Greenh..	2.4	24.4	10.9					15.7		53.3
Ozone		0.1								0.1
Acid.	1.0	1.9	2.6					1.5		7.0
Eutro.	6.8	4.9	2.9					16.4		31.0
Smog.	0.6	38.0	20.2					53.9		112.7
PM10	1.2	6.0	5.7					7.2		20.0
Dispers.	0.1	37.4	4.3					15.2		56.9

Table A.3 Sustainable National Income (variant 2) expressed as a Social Accounting Matrix 2005 (billion Euro, current prices) with emission accounts.

	Agr.	Ind.	Serv.	Cap.	Abat.	Trade	N.Inv.	Cons.	Endw.	Sum
Agriculture	36	-21	-3	-1		-3		-8		0
Industries	-5	169	-30	-22	-28	-12		-72		0
Services	-1	-20	147	-8	-7	-7		-104		0
Capital	-1	-8	-15	31			-7			0
Abatement	-3	-12	-4		37			-18		0
Labour	-1	-12	-39		-2				54	0
Profits	-2	-13	-24						38	0
Taxes										0
Greenh..	-21	-81	-27					-31	160	0
Ozone									0	0
Acid.									1	0
Eutro.									0	0
Smog.									0	0
PM10	-3	-3	-4					-3	13	0
Dispers.									0	0
Publ. abat.								14	-14	0
Sum	-0	0	0	-0	-0	-22	-7	-223	252	0
Greenh..	7.1	26.9	9.0					10.2		53.3
Ozone		0.1								0.1
Acid.	3.3	2.1	3.4					1.1		10.0
Eutro.	22.5	5.5	3.3					11.8		43.0
Smog.	2.0	29.5	15.7					38.8		86.0
PM10	3.9	5.4	5.5					5.1		20.0
Dispers.	0.3	25.9	3.2					10.2		39.7